Fishery Management Report No. 03-01

Fishery Management and Restoration Plan for the Harding Lake Northern Pike Sport Fishery, 2001–2004

by

Mike Doxey

February 2003

Alaska Department of Fish and Game **Division of Sport Fish**

Symbols and Abbreviations

The following symbols and abbreviations, and others approved for the Système International d'Unités (SI), are used in Division of Sport Fish Fishery Manuscripts, Fishery Data Series Reports, Fishery Management Reports, and Special Publications without definition.

Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
metric ton	mt
milliliter	ml
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
ounce	oz
pound	lb
quart	qt
yard	yd

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
hour	h
minute	min
second	s

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

All commonly accepted abbreviations.	e.g., Mr., Mrs., a.m., p.m., etc.
All commonly accepted professional titles.	e.g., Dr., Ph.D., R.N., etc.
and	&
at	@
Compass directions:	
east	E
north	N
south	S
west	W
Copyright	©
Corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
et alii (and other people)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.,
id est (that is)	i.e.,
latitude or longitude	lat. or long.
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
number (before a number)	# (e.g., #10)
pounds (after a number)	# (e.g., 10#)
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S. state and District of Columbia abbreviations	use two-letter abbreviations (e.g., AK, DC)

Mathematics, statistics, fisheries

alternate hypothesis	H_A
base of natural logarithm	e
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	F, t, χ^2, etc.
confidence interval	C.I.
correlation coefficient	R (multiple)
correlation coefficient	r (simple)
covariance	cov
degree (angular or temperature)	°
degrees of freedom	df
divided by	÷ or / (in equations)
equals	=
expected value	E
fork length	FL
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	$\log_2$, etc.
mideye-to-fork	MEF
minute (angular)	'
multiplied by	x
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
standard length	SL
total length	TL
variance	Var

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FISHERY MANAGEMENT PLAN AND RESTORATION PLAN FOR THE HARDING LAKE NORTHERN PIKE SPORT FISHERY, 2001–2004

by
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February 2003

The Fishery Management Reports series was established in 1989 for the publication of an overview of Division of Sport Fish management activities and goals in a specific geographic area. Fishery Management Reports are intended for fishery and other technical professionals, as well as lay persons. Fishery Management Reports are available through the Alaska State Library and on the Internet: http://www.sf.adfg.state.ak.us/statewide/divreports/html/intersearch.cfm This publication has undergone regional peer review.

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This document should be cited as:
Doxey, M. 2003. Fishery Management Plan and Restoration Plan for the Harding Lake Northern Pike Sport Fishery, 2000–2004. Alaska Department of Fish and Game, Fishery Management Report No. 03-01, Fairbanks.

TABLE OF CONTENTS

Page

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

PREFACE

The Alaska Department of Fish and Game (ADF&G) is the fish and wildlife management agency for the State of Alaska. The Division of sport fish is the management division within ADF&G that is responsible for the management of sport fisheries. The goals of Sport Fish Division are to conserve wild stocks of sport fish, to provide diversity of recreational fishing opportunities for the public, and to optimize the social and economic benefits from recreational fisheries for all Alaskans. To accomplish these goals the Division of Sport Fish has instituted a fisheries management process that relies on sound scientific principles and public involvement. Part of this process is the development of Sport Fish Management Plans for sport fisheries that are important to the public or that have characteristics that require focused management.

The Sport Fish Management Plan for northern pike in Harding Lake was a result of the public process, which included the regulatory prescription handed down by the Alaska Board of Fisheries. The open regulatory process of the Board of Fisheries enabled numerous opportunities for public participation in the development of regulations relating to this plan. The objectives found in this plan were developed around the implied intent of the regulatory process and the best available scientific information. The objectives should be viewed as dynamic and therefore should continue being the focus of discussions between managers, the public, and the Board of Fisheries.

Much of the information in these Fishery Management Plans is derived from a companion series of Fishery Management Reports published annually by Sport Fish Division. Readers of this plan are urged to consult the Fishery Management Reports for more complete background information on Sport Fish Division, fisheries management and management areas, and regulatory processes. As of August 2001, the most recent companion report to this plan is:

Doxey, M. 2001. Fishery Management Report for Sport Fisheries in the Lower Tanana River Management Area for 1999-2000. Alaska Department of Fish and Game, Fishery Management Report No. 01-05, Anchorage.

INTRODUCTION

BACKGROUND AND HISTORICAL PERSPECTIVE

Harding Lake is located in the central Tanana Valley, about four miles southeast from the confluence of the Salcha and Tanana rivers (Figure 1).

The Salcha River passes just north of Harding Lake, and the broad, braided floodplain of the Tanana River passes just to the west. The lake is about 35 miles southeast in a straight line and about 45 road miles on the Richardson Highway from Fairbanks. It is the largest, deepest, and most accessible of the four large roadside lakes (Birch, Harding, Chena, and Quartz lakes) in the central Tanana Valley and until Chena Lake was constructed, Harding Lake was the closest large lake to Fairbanks. Harding Lake has been used for all types of aquatic recreational activity over the years, including fishing (Doxey 1991).

Harding Lake is generally circular in shape, except for a prominent point in the middle of the southern shoreline, and is surrounded by forested hills except toward the Salcha Valley to the north. Surface elevation is about 715 ft, surface area is 2,500 acres, and maximum depth is 144 ft (Figure 2).

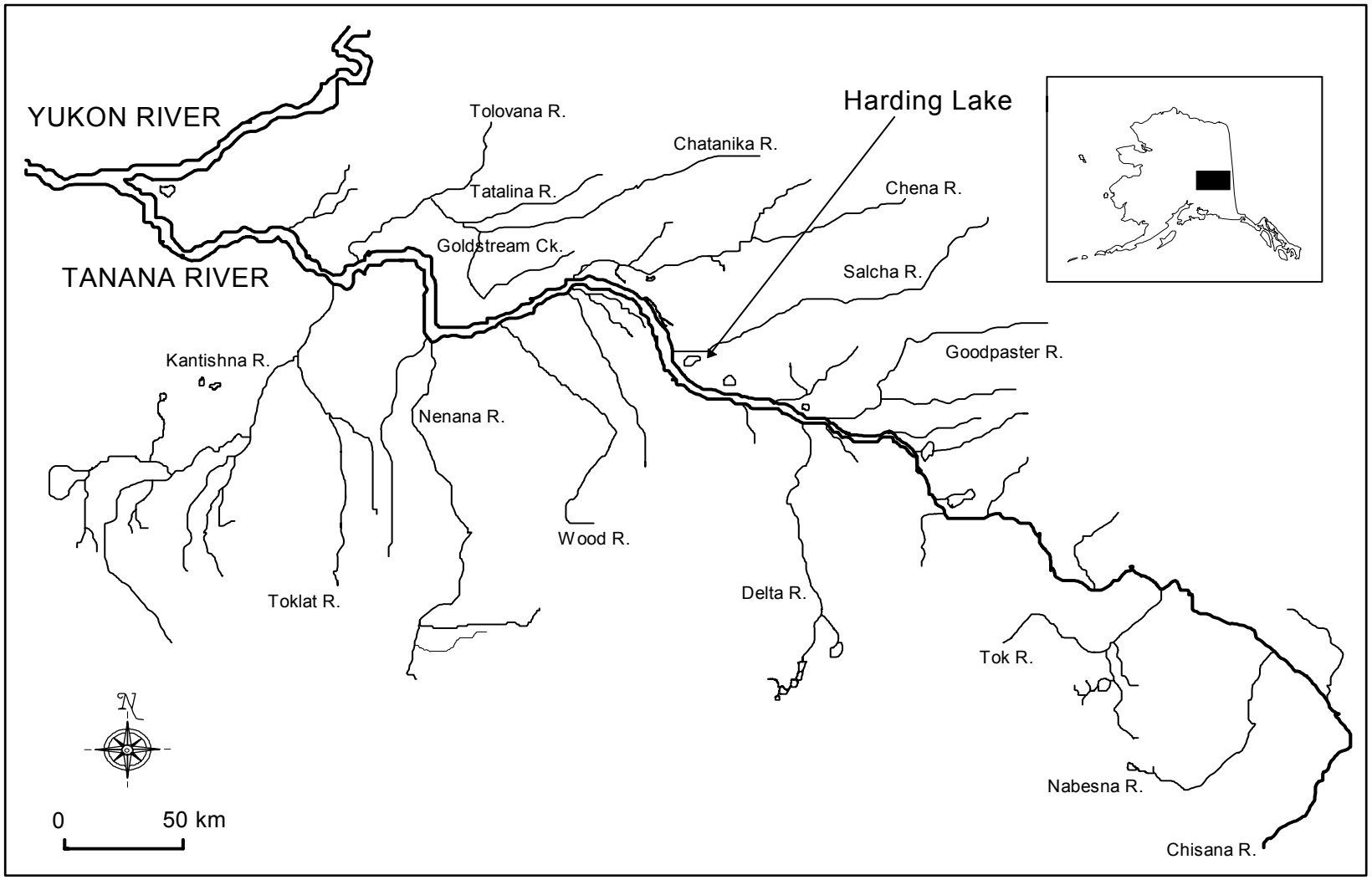

Figure 1.-Location of Harding Lake within the Tanana drainage.

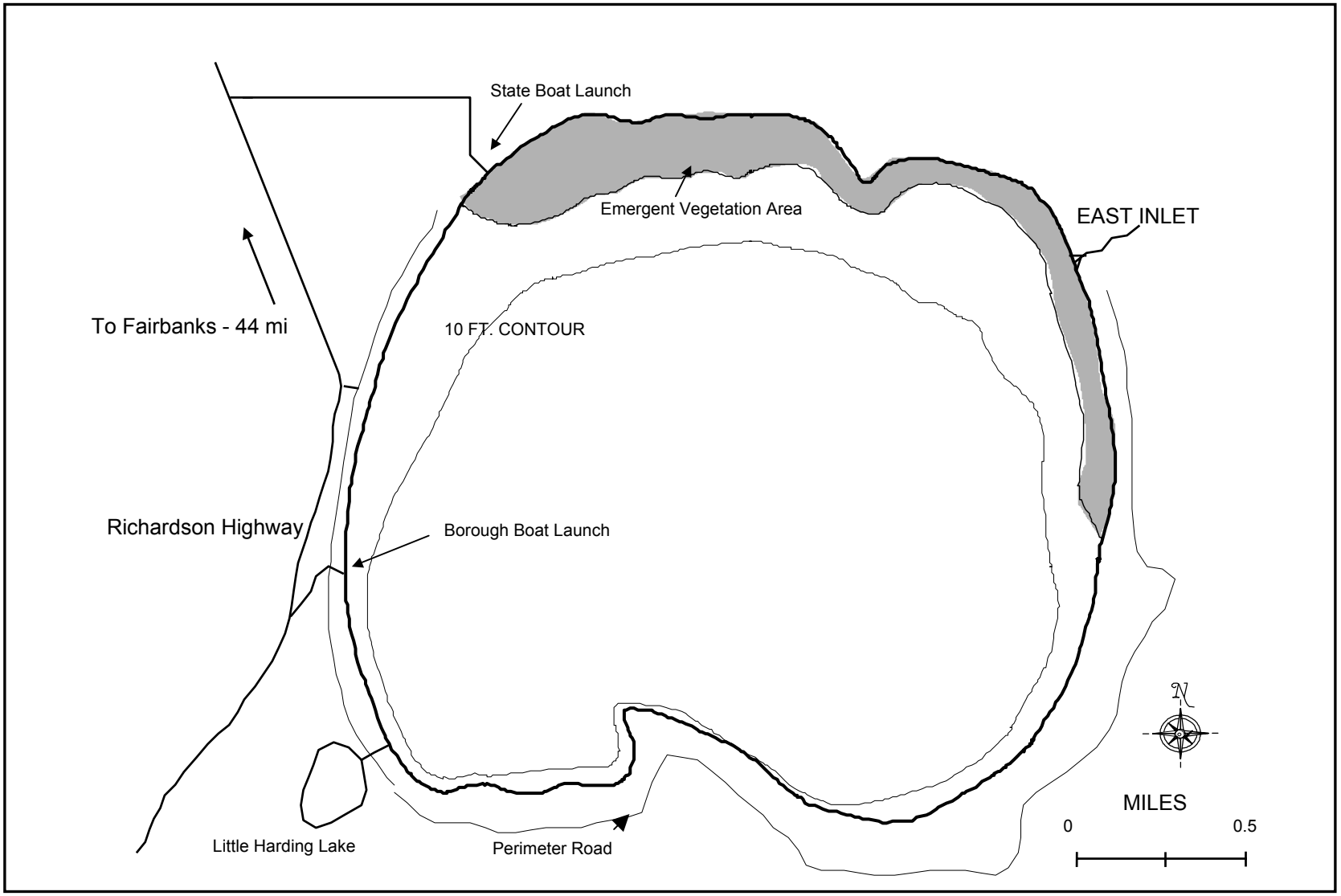

Figure 2.-Bathymetry and important features of Harding Lake.

This lake appears transparent green, and the lake is oligotrophic and relatively unproductive (LaPerriere 1975). There is no surface outlet, although water has been observed to flow into wetlands to the north during high water periods. The lake is fed by hillside runoff, a few springs, and two inlets. A small inlet drains the adjacent Little Harding Lake basin. The east inlet (Rogge Creek) drains a larger basin (approximately 6,400 acres) to the east. The channel of Rogge Creek comes to a divide at which the water periodically flows into either Harding Lake or the Salcha River. When the channel shifts such that the water flows toward the Salcha River, the lake volume and level is stable or declines depending on annual precipitation. When Rogge Creek flows into the lake, the lake volume and level remains stable or rises. When the lake level drops, the majority of the wetlands along the shoreline (principally the northern shoreline) dry up. This happened in the mid-1970s and again in the late 1990s. The dry flats were then colonized by terrestrial grasses and deciduous shrubs and trees. This phenomenon and its implications are described and quantitatively assessed in Nakao (1980), Kane (et al. 1979), and Doxey (1991). More complete descriptions of the lake are available in those reports.

Harding Lake is very accessible and sustains considerable utilization by local residents and visitors to the Tanana Valley. It lies within a spread-out rural community known as Salcha. About 75% of the shoreline is ringed with lakefront cabins which are road-connected to the Richardson Highway. There is a large State campground with a major boat launching area, and several other small public access right-of-ways and private boat launches. The boat launches become progressively more difficult to use when the lake level recedes, reducing angler access.

Indigenous fish species are northern pike *Esox lucius*, burbot *Lota lota*, least cisco *Coregonus sardinella*, and slimy sculpins *Cottus cognatus*. Introduced species are lake trout *Salvelinus namaycush* and Arctic char *Salvelinus alpinus*. The lake trout are naturally reproducing and have been augmented by small additions of hatchery fish. Natural reproduction of the Arctic char has not yet been documented and the fishery is entirely sustained by stocked fish.

The northern pike in Harding Lake provide the only major roadside northern pike sport fishery in Region III. They are a high profile game fish in Harding Lake because they are readily caught and their preference for shallow water habitats makes them highly visible to anglers. This is in contrast to the other large predators (burbot, lake trout, and Arctic char), which are available to anglers as lower density populations in deep water.

Because of its accessibility, the Harding Lake northern pike stock offers angling opportunity to a broad socio-economic and age spectrum of anglers of all income and angling experience ranges. These range from adults and youngsters fishing at their lakefront cabins, Salcha area residents making a short trip to Harding Lake, Tanana Valley residents living in Fairbanks and along the road system, and a few visitors from outside of Alaska. It is extremely popular with military personnel from Eielson Air Force Base and the Fort Wainwright Army Base. Anglers seeking a high-quality northern pike fishery, however, only occasionally and casually visit Harding Lake. This may be the result of fairly intense summer recreational activity on the lake and the limited potential abundance of large northern pike. Many of these anglers seek more remote pike fisheries.

Although effort is not estimated by target species (fishery), the majority of the effort at Harding Lake over the years is believed to have been directed toward northern pike. Estimated effort increased through the mid-1980s and ranged around 5,000 angler-days from 1990 to 1994

Table 1.-Estimated angling effort at Harding Lake, 1983-2000.

Year	Angler Days
1983	708
1984	1,707
1985	850
1986	2,064
1987	5,125
1988	3,256
1989	4,935
1990	3,895
1991	5,155
1992	5,068
1993	4,885
1994	4,913
1995	6,743
1996	6,734
1997	3,383
1998	3,410
1999	2,973
2000	2,538
Averages	
1983-99	3,870
1990-99	4,715
1995-99	4,648

(Table 1). Estimated effort increased to 6,700 angler days in 1995 and 1996, then declined thereafter to about 3,400 angler days during 1997 - 1998 and to 3,000 angler days in 1999.

As northern pike generally increased in popularity as a game fish (Doxey 1991) and anglers became more aware of their presence in Harding Lake, estimates of harvest increased through the 1980s (Table 2), then declined dramatically during the early 1990s (in part due to regulatory changes) and declined again after 1995. Estimated catches peaked in 1993 and declined slowly thereafter to about 800 in 1999. Prior to 1991, the Harding Lake northern pike sport fishery was regulated under the background regulations for Tanana Valley northern pike sport fisheries (Appendix A). In 1991, regulations specific to Harding Lake northern pike were implemented, closing pike fishing between April 1 and May 31 to protect spawning fish, imposing a 26 inch minimum length limit, and closing spear fishing.

Abundance estimates for northern pike were conducted at Harding Lake annually during the period 1991-1999 (excluding 1994). Abundance of northern pike over 12 inches in total length (300 mm in fork length) increased from about 2,300 in 1991 to about 3,800 in 1993. Estimated abundance increased between 1995 and 1996 from 2,338 to 3,337, but declined to 1,780 in 1997 (Roach 1998). The abundance estimate for 1998 was about 1,400 fish over 12 inches in length, which was a decline of about 16% from the estimate of 1997, and a decrease of about 44% from the average of the seven population estimates done between 1990 and 1997 (Roach and McIntyre 1999) and was the smallest since assessment efforts have been done.

In 1998 a risk and sustained-yield analysis was completed as part of the research studies on the Harding Lake northern pike population. The risk analysis assessed the ability of various regulatory regimes to maintain the northern pike spawning population at about 1,700 fish, the abundance calculated to produce maximum sustained yield (about 400 fish). The recommendation was to increase the minimum length limit from 26 inches to 30 inches (Roach and McIntyre 1999). Management intent was to pursue this recommendation at the January 2001 Board of Fisheries meeting. This option was put aside when the evidence of a recruitment collapse surfaced in 1999.

RECENT FISHERY ASSESSMENT

1999 - 2000

Estimated catch (828) and harvest (38) of northern pike in Harding Lake during 1999 was the lowest recorded. An abundance and age composition estimate revealed that the population of northern pike over 12 inches had declined to 583 fish and that a recruitment failure was occurring (Scanlon and Roach 2000). Only about 11% of the population consisted of young fish between age-1 and age-6. These diminished cohorts (ages 2-5) are the recruitment from strong parent classes (1993 -1997) when adult northern pike were abundant in the lake. The loss of most of the high-quality spawning and rearing habitat as the lake level dropped in the mid to late 1990s is assumed to have been the cause of the recruitment failures. Scanlon and Roach (2000) alluded to descriptions in fisheries literature of the importance, to survival of young of year northern pike, of vegetated zones like those that have disappeared in Harding Lake. Young pike prefer warm, shallow, productive, and sheltered areas. Cannibalism is a major mortality factor acting upon juveniles when cover is not available.

Table 2.-Sport catch and harvest of northern pike in Harding Lake, 1983-2000.

	Harding Lake	
Year	Catch	Harvest
1983	N/A[a]	178
1984	N/A	766
1985	N/A	503
1986	N/A	673
1987	N/A	1,886
1988	N/A	2,092
1989	N/A	1,764
1990	3,629	591
1991	5,071	1,888
1992	3,400	341
1993	8,471	391
1994	5,559	539
1995	3,852	502
1996	4,070	363
1997	1,665	62
1998	1,425	139
1999	828	38
2000	396	24
Averages		
1983-2000	N/A	748
1991-1999	3,797	485
1995-1999	2,368	221

[a] NA = data not available

Catch declined to 396 fish and harvest to 24 in 2000, largely because of an emergency order closure (described below). The residual catch and harvest is from a combination of effort during January - March 2000, when pike fishing was not closed, and perhaps some catch and harvest through the rest of the year by anglers unaware of the emergency order, which did not appear in the regulation books. A very small incidental catch of northern pike by anglers targeting the other large predators in the lake may continue but will likely be negligible.

MOST RECENT REGULATORY ACTIONS

An Emergency Order (effective May 1, 2000) was issued closing northern pike fishing in Harding Lake until the Board of Fisheries (BOF) could consider the situation.

During the January 2001 BOF meeting the Board adopted an ADF&G proposal closing Harding Lake to the taking of northern pike. This closure precludes targeting northern pike for catch and release (C&R). Management strategy restoring angling opportunity if and when the Harding Lake northern pike stock recovers was presented to the BOF during their deliberations. A management strategy presented to the public, to advisory committees, and to the BOF during deliberation of a proposal that was subsequently adopted represents a commitment to implementing that strategy by Sport Fish Division. The management strategy presented to the BOF for Harding Lake northern pike is included in this plan.

FISHERY MANAGEMENT ACTIVITIES/RESULTS

The declining population of adult northern pike in Harding Lake is indicative of a situation that may presently be not controllable while any fishing mortality occurs. The regulatory closure has effectively ended most legal fishing mortality for northern pike at Harding Lake, since the other game fish in Harding Lake inhabit deep water during the summer, when most of the angler effort occurs. Lake trout, burbot, and Arctic char are segregated from northern pike by habitat preference, and anglers targeting them seldom hook northern pike. Anglers have been alerted to the fact that fishing in the shallows of Harding Lake in the summer will not result in the taking of the deepwater species, and that hooking a northern pike in the shallows may be evidence of an attempt to take pike, a violation under the closure. Observation of anglers at Harding Lake during summers of 2000 - 2001 indicated good, but not perfect compliance. There is little winter fishing, and ice fishing method and location generally do not target northern pike at Harding Lake.

Ending fishing mortality may not allow the population to stabilize immediately, but it is believed northern pike will continue to exist in Harding Lake at low levels of abundance until spawning habitat is restored.

Progress is slowly occurring on planning for a public works project to control Rogge Creek water flow, which will result in rising lake water levels, thus restoring the wetlands that are so important to northern pike. The ADF&G is providing information and expertise in support of this project.

FISHERY OUTLOOK

Until the lake level rises and the dry flats along the north end of Harding Lake are recolonized by emergent aquatic vegetation, the outlook is dismal. Should the aquatic

habitat be restored, it is predicted northern pike abundance will increase rapidly as a low-density population takes advantage of large areas of unused habitat. Cannibalism, other predation, and competition for food and cover will be minimal when water levels return. It will likely be at least five years after a recovery begins before catch-and-release fishing can resume.

FISHERY MANAGEMENT OBJECTIVE

Sport Fish Division recognizes that the northern pike sport fishery in Harding Lake is the only major roadside northern pike sport fishery in Region III, and that as such, it must be managed to provide a mix of opportunities including a reasonable likelihood of harvest for those who choose to do so. The ADF&G intent is to structure the management regime for Harding Lake northern pike to allow restoration of harvest when the population recovers sufficiently.

> **The long term management objective for Harding Lake northern pike is to maintain a population within which abundance of fish with a fork length of 450 mm or greater exceeds 2,500 fish.**

Initially catch-and-release fishing will be proposed after abundance increases to a level at which the population can withstand mortality associated with catch and release without significant slowing of the rate of increase in abundance. When estimated abundance reaches 1,000 fish > 450 mm, catch-and-release fishing will be proposed. Opportunity to harvest northern pike will be proposed when estimated abundance of fish > 450 reaches 1,700 fish. Initial harvest opportunity will likely be restricted to a bag and possession limit of a single, large fish, but liberalization of both bag and size limit may be supported if the population exceeds 2,500 fish > 450 mm FL.

IMPLEMENTATION AND TIMELINE

Due to the nature of the situation and the uncertainty about when events leading to the recovery will occur, the timeline is described in terms of tasks, events, and thresholds, rather that in terms of calendar dates. It is possible that restoration of the fishery could occur within the period 2002-2010.

Three tasks have already been accomplished:

1. Harding Lake has been closed by regulation to the taking of northern pike.
2. Efforts to alert the angling public and enforce the closure have begun, and appear to be successful.
3. With the publication of this document, the management plan with thresholds for restoration of angling opportunity will be in place.

Future tasks, events, and thresholds, in sequence of likely occurrence:

1. **Habitat Restoration:** The ADF&G will encourage and support a northern pike habitat restoration project at Harding Lake. The Delta Soil and Water Conservation Service (NRCS-USDA), in conjunction with the Harding Lake Watershed Council (of which ADF&G is a participant) and the Harding Lake Association (a group of private citizens), is working to obtain funding from Congress to begin addressing several watershed issues at Harding Lake. The

three primary issues are lake water level, erosion into the lake, and water quality. The NRCS has committed to place the water level situation on a fast track for resolution. Resolution will involve determining optimum lake level, engineering and construction of a diversion structure to allow Rogge Creek flow to enter Harding Lake or the Salcha River as needed (as opposed to "at random" - the present situation) and operation of the structure to raise the lake level until northern pike spawning and rearing habitat is restored. ADF&G Sport Fish Division staff will provide input as to needed water level, some logistical support, professional services, and all available expertise to NCRS for this project. ADF&G Habitat Protection and Restoration Division staff are also actively participating on the Watershed Council and providing expertise and professional services. As the lake fills and covers its lakebed, ADF&G will consider a project to remove sections of berms that have formed in the flats along the northern shoreline, restoring fish passage to newly re-flooded spawning and rearing habitat behind those berms.

2. **Population Enhancement:** When a significant restoration of habitat occurs, the ADF&G will undertake enhancement of the northern pike population by locating donor stocks in the Tanana Valley from which adults can be transferred to Harding Lake to augment the spawning population. As spawning and rearing habitat is restored, up to 600 adult and subadult northern pike will be collected from Tanana Valley waters and stocked into Harding Lake. Whenever possible, a female to male sex ratio of 2:1 will be stocked. All introduced fish will be marked so that contribution to the recovery effort can be assessed.

3. **Population Assessment:** Assessment of abundance and age structure will become increasingly important as abundance increases and the potential to restore angler opportunity comes closer to reality.

    A. No abundance estimates or other invasive research activities will be undertaken until it is apparent that the northern pike population is increasing. Because northern pike inhabit shallow, accessible areas, the beginnings of a population recovery will be observed during foot and boat surveys of spawning and rearing areas. Indications of recovering will include the observation of increasing numbers of young fish of multiple age classes.

    B. After the recovery has begun, population monitoring will be undertaken. Abundance, age structure, and recovery rate will be assessed on a schedule appropriate to ensure the most expedient restoration of angling opportunity. Management actions to restore angling opportunity and achieve the long-term objective will be initiated and implemented. Catch and harvest will be monitored through the Statewide Harvest Survey and through on-site creel surveys as needed.

4. **Management Actions/Thresholds:** Angling opportunity will be restored in a series of steps. The spring spawning closure should remain in place. **Should**

thresholds triggering restoration of angling opportunity be reached in years when there is not going to be a Board of Fisheries meeting, Emergency Orders will be used to restore angling opportunity.

A. As abundance of northern pike over 450 mm in fork length increases through the threshold of 1,000 fish, the opportunity to catch and release northern pike will be proposed. A worst-case scenario hooking mortality of 5% will be used in assessing probable angling mortality during the catch-and-release fishery.

B. As abundance of northern pike over 450 mm in fork length exceeds 1,700 fish and the population age structure becomes compatible with maximum sustained yield, regulations allowing harvest of northern pike greater than 30 inches in total length with a daily bag and possession limit of one fish will be proposed. A MSY analysis indicated that sustainable harvest at this population status was 400 fish per year. This may need to be reevaluated if recovery conditions of the lake are substantially different then when the original analysis was conducted.

C. As abundance of northern pike over 450 mm in fork length increases beyond 2,500 fish and age structure analysis indicates that additional opportunity may be provided, the daily bag and possession limit will be increased to two northern pike, one greater than 30 inches and one larger than 30 inches.

D. As the population sustains itself and abundance increases with the more liberal regulations in place, additional opportunity such as decreases in size limit, increases in bag limit, and restoration of opportunity to harvest northern pike with underwater spear in summer and/or from spearing shanty in winter will be implemented to maintain the population near 2,500 fish > 450 mm FL.

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APPENDIX A

Appendix A.- Regulatory history of northern pike in Harding Lake.

These regulations in large part parallel the regulations governing northern pike in the Tanana drainage and in some cases the entire Region III until 1991.

1959

Regulations before Statehood (Alaska Game Commission)

- Open Season year-round.
- Daily bag and possession limit is 10.
- No size limit.
- May be taken only with hook and line or spear.

1962

Initial Regulations after Statehood (Alaska Department of Fish and Game)

- Open Season year-round.
- Daily bag and possession limit is 10.
- No size limit.
- May be taken only with hook and line or spear.

1969

Added size limit

- Open Season year-round.
- Daily bag and possession limit is 10.
- No more than two fish may be over 36 inches.
- May be taken only with hook and line or spear.

1970

Changed size limit, and eliminated use of spears

- Open Season year-round.
- Daily bag and possession limit is 10.
- No more than two fish may be over 30 inches.
- May be taken only with hook and line.

1973

Added season for winter use of spears

- Open Season year-round.
- Daily bag and possession limit is 10.
- No more than two fish may be over 30-inches.
- Open season for taking northern pike by spear is from October 1- May 31.

-continued-

1978

Use of spears underwater

- Open Season year-round.
- Daily bag and possession limit is 10.
- No more than two fish may be over 30-inches.
- Open season for taking northern pike by spear is from October 1- May 31.
- Northern pike may be taken by spear by persons completely submerged from January 1 through December 31**.**

1988

Limit Halved

- Open Season year-round.
- Daily bag and possession limit is 5.
- No more than one fish may be over 30-inches.
- Open season for taking northern pike by spear is from October 1- May 31.
- Northern pike may be taken by spear by persons completely submerged from January 1 through December 31**.**

1991

Size Limit Changed, C&R During Spawning, No Spearing

- Open all year, C&R during April 1 - May 31.
- Daily bag and possession limit is 5.
- None under 26-inches.
- Closed to take by spear and bow and arrow.

1993

Closed During Spawning

- Open June 1 - March 31, Closed during April 1 - May 31.
- Daily bag and possession limit is 5.
- None under 26-inches.
- Closed to take by spear and bow and arrow.

2000

Closed to the taking of northern pike by Emergency Order

- Closure to taking precludes targeting for catch and release.

2001

Closed to the taking of northern pike by regulation adopted by the State Board of Fisheries

- Emergency Order rescinded as regulation took effect.
- Closure to taking precludes targeting for catch and release.
- Basic plan to restore opportunity approved by BOF as part of proposal.